

Having thus described the preferred embodiments,
the invention is now claimed to be:

1. A method of magnetic resonance imaging
comprising:

- 5 (a) administering a magnetic resonance contrast agent
to a subject which contrast agent alters T_1 , T_2
and T_2^* magnetic resonance characteristics;
- (b) exciting magnetic resonance in a region of
interest of the subject which receives the
10 contrast agent;
- (c) applying a first echo planar readout waveform and
generating first image data;
- (d) applying a second echo planar readout waveform
and generating T_2 or T_2^* weighted image data;
- 15 (e) reconstructing the image data to generate a first
image representation and a T_2 or T_2^* weighted
image representation; and
- (f) correcting the T_2 or T_2^* weighted image
representation with the first image
20 representation.

2. The method as set forth in claim 1, further
including:

- applying an RF inversion pulse between the first and
second echo planar readout waveforms.
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3. The method as set forth in claim 1, further
including:

- applying a third echo planar readout waveform and
generating the other of T_2 and T_2^* weighted image
data.
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4. The method as set forth in claim 3, further
including:

- applying an RF inversion pulse between the second and
third echo planar readout waveforms, such that

the second echo planar readout waveform generates T_2^* weighted data and the third echo planar readout waveform generates T_2 weighted data.

5 5. The method as set forth in claim 4, further including:

reconstructing the T_2 weighted data into a T_2 weighted image representation; and

10 modifying the T_2 weighted image representation with the first image representation.

6. The method as set forth in claim 1, wherein the reconstructing step includes:

reconstructing the T_2 or T_2^* weighted image data and a portion of the first image data to generate the T_2 or T_2^* weighted image representation; and
15 reconstructing a portion of the T_2 or T_2^* weighted image data and the first image data to generate the first image representation.

7. The method as set forth in claim 6, wherein the
20 portion of the T_2 or T_2^* weighted readout waveform used to generate the first image representation and the portion of the first image data used to generate the T_2 or T_2^* weighted image representation include interleaved data lines adjacent an edge of k-space.

25 8. The method as set forth in claim 7, further including:

generating additional data lines by conjugate symmetry.

30 9. The method as set forth in claim 1, further including:

repeating steps (b)-(f) a plurality of times to generate a series of first image representations

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and a series of T_2 or T_2^* weighted image representations; and

combining the series of first image representations and the series of T_2 or T_2^* weighted image representations to generate a third series depicting a temporal evolution of the contrast agent in the region of interest.

10. The method as set forth in claim 1, further including:

(g) combining the first image representation and the T_2 or T_2^* weighted image representation to generate a third image representation; and repeating steps (b)-(g) a plurality of times to generate a series of third image representations depicting a temporal evolution of the contrast agent in the region of interest.

11. The method as set forth in claim 1, wherein the contrast agent includes a gadolinium chelate.

12. The method as set forth in claim 1, wherein at least one of the steps of generating the first image data and generating the second image data includes generating image data using a partial parallel imaging technique.

13. A method of contrast enhanced magnetic resonance imaging in which a subject is injected with a contrast agent, magnetic resonance is excited in a region of interest, the excited magnetic resonance is permitted to decay for a preselected duration to optimize one of T_2 and T_2^* weighting, and after the preselected duration an echo planar sequence is applied to generate T_2 or T_2^* weighted data, the method further including:

during the preselected duration, applying another echo planar sequence to generate T_1 weighted data.

14. A method for imaging a patient using a magnetic resonance (MR) imaging apparatus, said MR apparatus including a patient support means, a main magnet, a slice-select gradient pulse generator, a phase-encode gradient pulse generator, a read gradient pulse generator, a plurality of RF coils, an RF transmitter, and a receiver, the method comprising:

administering a contrast agent to the patient;
exciting a magnetic resonance in the patient using
10 the RF transmitter and at least one of the plurality of RF coils in conjunction with the slice-select gradient generator;
encoding and reading the magnetic resonance using the phase encode and the read gradient generators in conjunction with at least one of the plurality
15 of RF coils and the receiver, the encoding and reading implementing a first echo-planar readout waveform;
encoding and reading the magnetic resonance using the phase encode and the read gradient generators in conjunction with at least one of the plurality
20 of RF coils and the receiver, the encoding and reading implementing a second echo-planar readout waveform; and
reconstructing the encoded and read magnetic
25 resonance into first and second image representations.

15. The imaging method according to claim 14,
30 further comprising:
comparing the first image representation with the second image representation to obtain a third image representation thereby.

16. The imaging method according to claim 15,
35 further comprising:

repeating the steps of exciting a magnetic resonance,
encoding, reading, and reconstructing first and
second images, and comparing the first images
with the second images to obtain third images
thereby; and
determining a temporal evolution of at least one of
the first image, the second image, and the third
image.

17. The imaging method according to claim 14,
wherein:
in the step of reconstructing the second image, a
portion of the encoded and read resonance from
the first echo planar readout waveform is
reconstructed into the second image.

18. The imaging method according to claim 14,
wherein:
the first echo planar readout waveform phase encoding
includes,
phase encoding a first portion of the
resonance such that a k_y component
single-steps in a first direction, and
phase encoding a second portion of the
resonance such that the k_y component
double-steps in the first direction;
the second echo planar readout waveform phase
encoding includes,
phase encoding a first portion of the
resonance such that the k_y component
double-steps opposite to the first
direction, and
phase encoding a second portion of the
resonance such that the k_y component
single-steps opposite to the first
direction; and
the reconstructing step includes,

reconstructing the first and second portions of the first echo planar readout waveform and the first portion of the second echo planar readout waveform into the first image representation, and
5 reconstructing the second portion of the first echo planar readout waveform and the first and second portions of the second echo planar readout waveform
10 into the second image representation.

19. A magnetic resonance imaging apparatus comprising:
a main magnet which generates a temporally constant
15 magnetic field through an examination region;
an RF system which excites and manipulates magnetic resonance in the examination region and which receives and demodulates magnetic resonance signals from the examination region into data
20 lines;
a sorter which sorts the data lines between a first data memory and a second data memory;
a gradient magnetic field system which generates magnetic field gradients across the examination
25 region to spatially encode the resonance signals;
a sequence controller which,
(i) controls the RF system to induce resonance;
30 (ii) controls the RF and gradient systems to implement a first echo planar readout waveform which generates T_1 weighted data lines;
(iii) controls the RF and gradient systems
35 to implement a second echo planar

readout waveform which generates one
of T_2 and T_2^* weighted data lines, and
(iv) controls the sorter to sort the T_1 and
 T_2 or T_2^* weighted data lines between
5 the first and second data memories;
and
a reconstruction processor which reconstructs data
lines from the first data memory into a first
image representation and data lines from the
10 second data memory into a second image
representation.

20. The magnetic resonance apparatus as set forth in
claim 19 further including:
a means for injecting a contrast agent into a subject
15 in the examination region; and
an image processor for combining the first and second
image representations into a contrast agent
enhanced image representation.

21. The magnetic resonance apparatus as set forth in
20 claim 20 wherein:
the sequence controller controls the sorter to sort
(i) all of the T_1 weighted data lines and a
portion of the T_2 or T_2^* weighted data
lines into the first image memory and
25 (ii) all of the T_2 or T_2^* weighted data
lines and a portion of the T_1 weighted
data lines into the second image
memory.

22. The magnetic resonance apparatus as set forth in
30 claim 19 wherein the RF system further includes:
a phased array receive coil; and
a partial parallel imaging (PPI) integrator which
processes the readout of the phased array
receive coil to generate data lines.

23. The magnetic resonance apparatus as set forth in claim 22 wherein the partial parallel imaging (PPI) integrator processes the readout of the phased array receive coil using one of a simultaneous acquisition of spatial harmonics (SMASH) technique, a sensitivity encoding (SENSE) technique, and a parallel imaging with localized sensitivities (PILS) technique.